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ABSTRACT

This paper on a research project on aural learning briefly (1) describes some of the difficulties which define the problem of aural learning; (2) discusses how that problem has been attacked in the past and why the author has elected not to follow that tradition; and (3) outlines an alternative approach. Research procedures are outlined and included (1) obtaining references through several ERIC and PASAR computer searches and conducting literature review; (2) designing a research plan to produce teaching materials and procedures by which visually handicapped students may learn more effectively through listening (immediate target population was comprised of visually handicapped adults--those over 16 years of age, out of school, who have not completed a high school education); and (3) outlining this alternative plan. The final section of this paper describes the following three forms of structural adaptation involved in the new alternative approach to aural learning: (1) Temporal; (2) content, and (3) sequential. A figure showing parts of the preliminary adaptation structure for aural study is appended. (LAS)

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SOS RESEARCH: A NEW APPROACH TO AN OLD PROBLEM[1]

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Since January of 1976, we have been working on a problem: the problem of learning through listening. In the first few months, our efforts were concentrated on finding out about that problem and what others had done in attempts to facilitate aural learning. Many hundreds of references were obtained through several ERIC and PASAR computer searches of different sets of descriptors related to listening in general, the teaching of listening skills, the measurement of listening abilities, and learning through listening (referred to here as the literature of listening). An annotated bibliography of the references most relevant to our research is one product of our initial funding period (Cobb, E.S. Listening bibliography. In, Document No. 2, Final Report, June 1976, 29 - 93).

Having informed ourselves through literary study and personal contacts with many researchers in the field,[2] a research plan was designed, the primary purpose of which is to produce teaching materials and procedures by which visually handicapped students may more effectively learn through listening. Since the Learning Through Listening project is funded under the Adult Education Act, as administered by the Bureau of Special Continuing Education of the New York State Education Department, our immediate target population comprises visually handicapped adults -- those who are over sixteen years of age, out of school, and who have not yet completed a high school education. It is clear, however, that any popu-

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lation of aural learners is a potential beneficiary of the efforts of our research.

The purpose of this article is to briefly describe some of the difficulties which define the problem of aural learning, to discuss how that problem has been attacked in the past (and why we have elected not to follow that tradition), and, finally, to outline an alternative approach, which is the research plan we have been implementing for the past few months.

THE PROBLEM OF AURAL LEARNING

When we are talking about aural learning (or learning through listening) we are referring to the specific case of independent study of tape recorded material. And when we speak of the problem of aural learning, we mean, in particular, difficulties relative to independent study by reading printed matter. The tape-recorded educational materials which are currently available for visually handicapped students (e.g., from Recordings for the Blind, Inc.) are literal transcriptions of books. It is studying from literal transcription tapes, as opposed to reading the books from which they were recorded, which constitutes our problem of aural learning. The difference is best described in terms of student control over the presentation being studied.

In order to appreciate the difference which gives the visual learner an advantage over the aural learner, consider for a moment a comparison between two extremes: listening to a lecture in a classroom and reading the same presentation. When reading, there are several things a student can do which are not possible -- or at least very impractical -- when listening to a speaker. For one, the student can simply stop reading at any point and engage in any of a number of study activities: re-state what has been

read in more familiar terms; formulate a question and attempt to answer it; look up a definition; refer to another source; underline a passage; deduce an example; generalize; and so on. And, what is of special importance to the distinction we are describing, these kinds of study activities can all occur with the written presentation conveniently available for selective re-reading.

There are other important forms of the interaction with and control over a printed presentation. The student can easily control the rate of presentation by reading slowly or more quickly, can skip over material or read selectively in other ways, and can also obtain a preview of what is about to come. All these alternatives represent a substantial set of advantages for the student who reads. They are study activity options for control over a presentation to be learned which are, for the most part, not even possible for a student passively listening to a speaker.

When a student is studying a presentation on a tape recorder, many of the above-mentioned reading activities can be simulated, but not nearly as comfortably. All of them are encumbered by the fact that the student does not have the presentation readily available for review and thus must depend upon the short-term memory of what has been recently heard.

Finding material -- or what, in the literature of listening, is called search and location -- is <u>one</u> of the problems of reviewing part(s) of a presentation. A sighted student may want to review something read over an hour before and be seconds away from finding it. In contrast, the aural learner may end up spending a substantial amount of time locating a part of a presentation which was heard only minutes before. The student who reads has the presentation conveniently divided up into structured parts: pages, paragraphs, headings and sub-headings in different kinds of print; and, as

a last resort, there is usually an index and/or table of contents. If search and location were the only disadvantage of aural study, it would certainly merit our attention.

But, of course, it is not. It is part of the problem of reviewing (the other part being the fact that the aural learner cannot review as selectively as the reader), which in turn is part of a larger problem. For example, with some tape recorders, student control over the rate of presentation is possible, but again, relatively cumbersome and time-consuming. And, there is no effective aural analogue to "scanning ahead" for a preview.

Thus, although many study activities which are possible for a student who reads are also options for the student who listens to tape-recorded presentations, in many cases the aural learner may not engage in them simply because it is too much bother to do so. And when that happens, much of the listener's time is spent in conditions which more closely approximate those of a lecture in a classroom than those of a student independently studying the printed word. As we have pointed out, those conditions are the extreme case of the problem of aural learning -- the case where student control over, and interaction with, an oral presentation must be at a minimum.

Many of the above limitations to aural study of tape recorded presentations are necessarily true and experimental data describing the differences between visual and aural study, if they existed, would simply inform us of the extent to which they are true. Other limitations arising from differences in what listeners vs. readers will "bother" to do while studying are important and even probable, but they have been suppositional to date. For example, we suppose that when a student engaged in the independent study of a literal transcription tape does stop the recording machine, it

may often be for reasons we would like to avoid, if possible (e.g. confusion, overloading of memory, awareness of lack of attention, sheer boredom, or frustration).

Experimental data which are precise measurements of how students study literal transcription tapes, as well as a variety of other recorded presentation structures, have been obtained for the past few months in the aural learning laboratory of the Learning Through Listening Project. These pilot data, and of course, the laboratory instrumentation developed to provide them, are the major innovation of the research plan to be described below. We believe that our experimental approach -- which we refer to as the "study of study" (or, SOS) research -- constitutes a very different and potentially more effective one than previous efforts at doing something to facilitate aural learning. The main thrust of those efforts has been aimed at teaching students so-called "listening skills" in the hope that such training would provide the basis from which the student could generalize to any aural presentation. In fact, the basic assumption in the literature of listening is that teaching students to be "better listeners" will be reflected in positive transfer from having completed a how-to-listen-better course, and will compensate for the problem of aural learning; or, at the very least, facilitate aural learning in an absolute sense. That assumption, and several others related to it, are the subject of a critical discussion in the following section.

LISTENING SKILLS -- THE TRADITIONAL APPROACH

The substance of this section is drawn from Document No. 5, entitled, Listening Skills, of the Final Report for the first funding period (Cobb, 1976, 116-157). Our annotated bibliography contains references which are clearly exceptions to some of our discussion of the traditional approach (Document No. 2 of the Final Report), and we will not list them here. There are several

good reviews of the literature of listening which provide a fair sample of the referant for our present discussion (see, for example, Daugherty, 1974; Ducker, 1968; Lundsteen, 1971; Stocker, 1970).

From a nominal consideration alone, a new-comer to the field of listening might well ponder the meaning of the term "listening skills." Transformations of the term which represent analogues to other senses seem quite foreign: seeing skills, smelling skills, and so on. The same is true for statements containing the term, or derived from it. Consider, for example, If we teach students the basic listening skills, they will become better listeners." That kind of statement is quite common in the literature of listening. Now consider its visual analogue: "If we teach students the basic seeing skills, they will become better seers.:

Clearly "listening" is not comparable to words like seeing, smelling, etc., and it is true that the literature often makes a distinction between hearing and listening. It is probably safe to say that the latter is always understood to include the former, and that would allow for the many cases where the terms are used interchangably, but we have seen that listening must mean something in addition to hearing. What then?

A brief perusal of a random sample of the literature of listening would reveal that "listening", in addition to meaning "hearing", means aural language comprehension, and that a close visual analogue to "listening skills" is "reading comprehension skills." There are, of course, numerous kinds of exceptions to that generalization (e.g., listening includes such matters as remembering and attention; and some distinctions are made with respect to hypothetical events which are said to take place inside the listener as opposed to a person who is "processing visual stimulation")' but if it were understood that the most generic meaning of "reading comprehension" could include such matters as an appreciation of

the difference between inductive and deductive inference, the identification of various logical fallicies, the distinction between connotative and denotative meaning, and so on, there would probably be good agreement that most of what is meant by "listening skills" is quite adequately covered by the terms "hearing" plus all that is meant by "reading comprehension skills" (with, perhaps, the exception of a few "communicative skills" which are specific to the question of classifying non-verbal sound variations in the out-put of a speaker).

That, of course, is a lot and should be kept in mind when the reader comes to our discussion of programs which have attempted to produce "better listeners." For now, it will suffice to simply point out that a lack of language comprehension is not the problem of listening as we have described it -- it is the problem for education in general. The ignorance of most of what is taught under the rubric of "listening skills" is every student's problem -- not just the aural learner's. So whatever benefit is accrued from having completed a how-to-listen-better course would hardly be restricted to a student studying with a tape recorder. For examples, learning how to "get the main point" of a short passage presented for aural consumption is not going to be a very different "skill" from learning how to respond in the same way to the same passage printed on a page. Or is it? In any case, we have seen no evidence to make the assumption that such skills are different. That is one of the assumptions, implicit in the literature of listening, which we would question.

Before we be condemned for "missing the point" of the literature of listening, consider another assumption of that body of knowledge: that even though reading comprehension skills and listening comprehension skills may not be mutually exclusive, they are necessary pre-requisites for general comprehension and are taught to best advantage as such, in a separate course, independently of any other subject matter (e.g. as "exercises").

That, of course, is another implication of courses which purport to teach people to be "better listeners", and we wonder where the evidence for that assumption exists. Certainly it is not in the literature of listening. If it comes from the literature on reading comprehension, our questioning of the first assumption is all the more reasonable.

Consider a sample of the kind of repertoire how-to-listen-better courses attempt to impart: "get the main points;" "remember details;" "summarize a presentation;" "make an outline;" "make comparisons;" "classify mixed items;" "distinguish cause from effect;" "predict outcomes;" "distinguish fact from opinion;" "draw conclusions;" "recognize conflict;" "follow directions;" "ask questions about a presentation;" "identify persuasion;" "make inferences;" "imitate;" and so on. Obviously, any student who has learned how to respond to presentations in the above ways is going to learn them more effectively. There is no question, for example, that knowing "how to think" will help any student learn a new presentation, whether it be read or heard. But there is a question about how such abilities are most effectively acquired by a student. The assumption that they should (or even can) be taught directly in a single course, under the rubric of "listening skills," is what we are questioning.

The alternative is to work toward those goals of education indirectly, as a part of learning to understand any subject. That is a long-term process, but if we evaluate student comprehension of any subject with the high standards implied by "listening skills", students will gradually approach the same achievements we hope for in how-to-listen-better courses. For example, if we consistently evaluate aural learners appropriate to their ability to "get the main points" of a reference in American history, we see no reason why they won't learn to do that, and learn American history as well.

In any case, with the indirect approach, we are less likely to conceive of our pedagogic accomplishments as "listening skills."

Leaving aside the relative effectiveness of procedures for teaching "Listening skills", and the issue that, if established, they do not compensate for the difficulties of aural study relative to visual, there is still the fact that proficiency in the curriculum of listening skills courses would facilitate independent study of tape recorded material in an absolute sense. Of course, that is true, but it should be noted that the advantage would be entirely restricted to those students who attained the proficiency. That is a severe practical limitation of the traditional approach to the problem of listening. The success of that approach depends entirely upon our success in teaching the curriculum of listening skills courses. Much of that curriculum has been an especially troublesome goal throughout the history of education.

We are sure that there are many people who fervently believe in the value of how-to-listen-better courses, but we have found no convincing evidence in the literature of listening to support their cause. Convincing evidence would , indeed, be very hard to come by, for the problems in defining a given "listening skill," then teaching specific responses to specific presentations under a given set of learning conditions, then showing the performance established provides the basis for generalization to new material under different performance requirements, do not constitute an easy task.

For example, take the skill of "remembering details" of aural presentations. After defining what a "detail" is, as separate from other properties of verbal presentations, we would then have to show that students significantly improved in their ability to remember the specific details

presented to them, under instructional conditions which presumably included differential feedback for their attempts to remember them. Then we would have to show that our students were, as a result, better able to remember other kinds of details, embedded in other kinds of verbal contexts, under other kinds of performance conditions (e.g. independent study of literal transcription tapes). Otherwise, what would be the point? The literature of listening suffers greatly from a lack of even some of that kind of evidence for some "listening skills."

Our own research into the literature of listening has brought us to the point where we are no longer saying that students need to "learn how to listen better", but rather that they need to "learn how to listen to something better". Initially, that may not sound like a very substantial distinction, but we feel that it casts the whole problem of facilitating aural learning in a different light. Many of the questions which arise when we try to teach students how to listen may well be pseudo-problems. When we try to teach them something aurally, on the other hand, other kinds of questions become important -- questions which can be attacked more effectively.

We have already made analogies to the other senses to show that listening is a word which refers to much more than a word like seeing, at least as it is used in the literature we have examined. Whether or not "listening skills" is a misnomer is really not our interest. It may be useful, however, to go back to a visual analysis and compare it with our conception of listening.

Sighted people need training in how to see something, but not to see. If it is art appreciation, then they learn to discriminate certain properties of paintings; if they are studying hematology, then they learn to see

subtle differences in microscopic samples of blood; if they are driving a car, it is important to learn to respond to complex visual displays in a variety of ways. The art connoisseur, hematologist, and driver have not learned how to see, but rather to respond to particular displays they see. The hematologist is not better at "seeing" than the driver of the car, he is better at seeing something.

By the same token, we don't need to learn "how to listen". An ornithologist learns to discriminate the vocalizations of a robin from a blue jay; a musician, to hear the voices of a four-part fugue as independent from one another; and a Morse Code operator makes other kinds of auditory discriminations. All three learn to respond differentially to different classes of auditory stimuli. One doesn't hear better (or, if you will, "listen" better) than another. They are all better at listening to particular kinds of presentations. And if the presentations are verbal, again the same analysis pertains.

If a student doesn't understand simple sentences when they are presented for aural learning, then we can go about teaching that student to differentially respond to simple sentences in ways which reflect understanding of the content we are trying to teach. But that isn't teaching the student how to listen. And if a student does understand simple sentences, as evidenced in some situations, but fails to make responses which reflect comprehension in a teaching setting, again the problem should not be expressed appropriate to knowledge of how to listen. The problem remains what it always was: the student doesn't listen to particular materials in particular situations. In that case, language comprehension is no more the problem than poor "listening ability", and other kinds of solutions are in order.

Clearly ther are grammatical, syntactic, semantic, and logical rules which can be used to describe the production and reception of language. There are rules which refer to the meaning of parts of words, words, and groups of words, and so on. Because such properties of language are generic, some of them may be useful to learn about and practice per se. If so, however, the value of such skills remains to be demonstrated for the case of aural learning.

If, for example, we were to invest time teaching the visually handicapped students on our project a how-to-listen-better course, where is the evidence that such training would make a significant improvement in the independent study of content on a literal transcription tape? What content? Which content would be most facilitated by which "listening skill"? And if training time were invested in teaching something else, how do we know that some, or most, of what the listening skills course teaches wouldn't be a by-product of learning the other content? In fact, some data from the literature of listening suggest that it would! (See for example Stocker, 1971) But there are no unequivocal answers to any of those questions.

The main thrust of the original proposal of the Learning Through Listening project was to establish in visually impaired students a repertoire of "listening skills" in a pre-training course, in the hope that their aural learning of subject matter in preparation for high school equivalency would be significantly facilitated. The points we have made about "listening skills" in this section were a sufficient basis for turning our attention to an alternative approach to the problem of listening which is described in the next section.

SOS RESEARCH -- THE NEW APPROACH

How-to-listen-better courses are an attempt to facilitate aural learning by changing the student. Our new approach to the problem of listening is to change the presentations which the student studies aurally. Thus, rather than have students study tapes which are literal transcriptions of the presentation structure of books, that structure is adapted in ways which facilitate learning through listening from tape-recorded presentations.

For the past several months, experimental student/subjects have been engaged in the independent study of special tapes which have been recorded in our preliminary adaptation structure. Our student/subjects are, of course, all adults, out-of-school, with less than a high school diploma. They are referred to the project through a collaboration agreement with the Lighthouse (New York Association for the Blind). They are providing us with experimental data on the relative effectiveness of variations in the presentation structure of tape-recorded materials. The discussion to follow centers on a description of our preliminary adaptation structure, the rationale for it, and the methods by which we hope to improve upon it.

There were two main considerations in selecting the adaptation structure for aural learning that we have been using so far: one concerned the problems of search and location and the other concerned strategies by which we could increase the probability that students would engage in study activities which were available to them -- study activities which contribute to comprehension. The two concerns are, of course, interdependent, for if we can make it easier for an aural learner to find material for review, that student is more likely to bother to interact with a presentation in other ways which promote understanding of it. After describing our adaptation structure appropriate to those properties which facilitate search and location, we will discuss its pedagogic value in terms of facilitating student comp-

rehension.

Our adaptation structure now involves three kinds of modifications of literal transcription structures. The first we have called temporal adaptation, for it places a constraint on the amount of time a student spends engaged in a particular sequence (see below) of study activities. This limitation is accomplished quite simply: the tape-recorded material is divided up into given amounts, called listening segments. Since listening segments can be indexed with high frequency tones, the beginning and end of each can be easily located by numbering them. Thus a student who is studying listening segment (LS) #5, can locate LS #2 by rewinding and counting the occurance of three high frequency tones. Stopping the playback recorder at the third tone, the student is located at the end of LS #1 and the beginning of LS #2.

Our second kind of structural adaptation is called content segregation. This means that the presentation to be learned in an LS is not presented on one tape track (as is the case with literal transcription tapes), but rather is further divided by recording it on two separate tracks, called channels A and B. The two channels run concurrently, so that when a student is listening to channel A of a given LS, channel B is moving through the tape recorder. Since channels A and B always begin at the same point on the tape (i.e., the beginning of an LS), if a student listens to channel A first, the tape recorder must be re-wound to the beginning of the LS, after which moving a "channel selector" switch will allow the student to hear channel B of that LS from the beginning.

Content segregation can, with only two channels, reduce a student's search and location time by one half, provided the student knows which channel the "target" material is recorded on. That is because the channels

are approximately equal in length, So if an LS contains ten minutes of recorded material, about half of that material is on each channel. Thus, a student who knows that target material is located on one of the two channels has only five minutes of tape to cope with rather than ten. The question of how a student can know what channel target material is recorded on will become clear from the discussion to follow.

The third kind of structural adaptation is called sequential adaptation and consists of maintaining a standard order of presentation on each channel of each LS. Thus, channel A of a given LS always begins with an identification of the LS number followed by a title which indicates what the LS is about. The title is followed by textual material called the "exposition" (i.e., the student is initially "exposed" to the material of the LS). A numbered list of questions about the content of the LS follows the exposition, and channel A ends with another identification of the LS number. Channel B also begins with an identification of the LS number, followed by a different kind of textual material presentation (see below) called the "commentary". And channel B always ends with a numbered list of "main points" covered in the LS, followed by another LS number identification.

Figure 1 illustrates temporal adaptation, content segregation, and some of the sequential adaptation we have just described. Briefly, students on the Learning Through Listening (LTL) project learn courses which are recorded on cassettes. Each cassette has two sides, called tapes (or units). A tape represents one hour's worth of recording at our normal play speed of 1 7/8 ips, separated into 30 minutes of channel A and 30 minutes of channel B. The 30 minutes of taped material is divided into "n" listening segments which depends upon the average LS length for the tape.

Insert figure 1 about here

Figure 1 shows that each LS contains four major parts which are initially listened to in the following order: Channel A exposition, Channel B commentary, Channel B review, and Channel A questions. The location of interrogatory and review material within an LS is always known since those LS parts are numbered consecutively and occur on different channels. Differentiating exposition from commentary material is not quite as easy for the student, but once they get used to the differences between them, they are usually able to make correct assumptions about what channel to go to. Those differences are not so easily specified.

For the most part, the exposition contains the "core" content of the LS. For example, if an LS is teaching a new word and its relatinn to three other words which the student already knows, the exposition would contain a formal definition of the new word and reference to the three relationships. Of the two parts, the exposition is usually the more generic.

The commentary of an LS is always <u>about</u> the exposition. It is more specific, tutorial and explanatory. It contains examples and expansions of the points made in the exposition, as well as background information. Where possible, the sequence of treatment in the exposition is preserved in the commentary. For example, the commentary would first contain additional information about the new word introduced in the exposition, followed by subsidiary points about each of the three relationships, in the order in which the student was exposed to them.

So sequential adaptation also pertains <u>within</u> the exposition and commentary. The student is assisted in knowing that sequence, as well as what was said on each of the channels, from the sequential presentation of the review. The order of main points in the LS review follows the order in which the student initially hears the LS text. ——————→

Thus the review starts with the exposition sequence and ends with the commentary sequence. So the student can use the review, if necessary, to differentiate between channels and within the text of each channel.

Sequential adaptation also pertains for the last part of each LS -- the questions at the end of channel A. The numbered sequence in the review is correlated with the sequence of numbered questions, for the questions are about the main points. Thus if the student, who must answer each question on a separate response recorder, understands that the first question is about the new word but cannot remember the new word, a quick return to main point number one is the easiest way to find it. The location of each of the four LS parts is designed to require a minimum of re-winding for typical patterns of study.

Not only is sequential adaptation part of the structure of an LS, it is used to facilitate search and location within a tape, which is one hour's worth of recording (30 minutes on each channel). The number of listening segments on a tape can vary, depending on the average LS length. The first and last segments, however, provide sequential information to the student about the contents of the tape. Both segments are very short. The first LS gives the title of each of the following segments on channel A, and lists new words or phrases for each of the segments on channel B. The last LS is a summary of the tape which is also treated sequentially. Thus the student can discover the essential content of a tape by either going to the beginning of it or the end of it, whichever is more proximal.

In summary, our three forms of structural adapataion substantially reduce the problem of search and location which exists for the study of literal transcription presentation structures. Temporal adaptation

facilitates gross location on a tape; content segregation cuts the amount of material to be searched through in an LS by one half; and sequential adaptation assists the student in locating target material within each part of the adaptation structure.

As we have said, the rationale for that preliminary structure includes more than considerations of search and location alone. In fact, the application of several principles of learning was, perhaps, the main set of considerations which generated most of the features of the structure which we are using. A third set of considerations also influenced the way we are presenting material for aural study: these are experimental considerations. The structure allows for the quantitative variation of some of its properties so that an experimental analysis can provide information on how student study interactions and degrees of comprehension are functionally related to those variations in our presentations.

A meaningful description of the relations between our preliminary adaptation structure and our concern with several principles of learning is well beyond the scope of this paper. That is especially true in view of the fact that the structure itself is related to a system of instruction we are using on the LTL project which is also not being discussed in this paper. For those readers who are interested in our teaching procedures, see appropriate articles reprinted in The Personalized System of Instruction (Sherman, 1974). The same is true for our interest in experimental manipulation of properties of our adaptation structure. We will, however, discuss the nature of a few pilot experiments at the end of this article.

Without going into details, the reader can still appreciate some of the general study advantages of learning with adapted tapes. First of all, the student can be much more active in the ways in which he/she

can respond to the tape-recorded presentation. Not only does the student compose and tape record short verbal answers in response to channel A LS questions, but the structure provides the student with guidance in responding covertly throughout the study of each LS. The channel B commentary compliments the channel A exposition in such a way that hearing the commentary will often increase the comprehension of what is said in exposition. And the review of main points provides the student with learning objectives for each LS. Each of the four parts of an LS provides us with the opportunity to say the same thing in a slightly different verbal context . All in all, we have good reason to believe that the structure permits the student to more easily engage in self-evaluation and other study activities which are extremely difficult when literal transcription tapes are studied.

The literature of listening had given us ample reason to look for an alternative approach to attacking the problem of aural study, but there was next to nothing in that literature which even hinted at how to adapt materials for learning with tape recorders. There was, of course, a body of knowledge on programmed instruction, and we have used some of the principles of linear programming in writing materials; but, aside from that, we were left without much to go on.

The absence of answers to our questions about how to effectively adapt materials for aural study turned out to be a fortunate circumstance for us. Out of that void in the literature came the notion that we would have to learn how to adapt effectively for ourselves. And out of that state of deprivation emerged the idea that we could learn something about the effectiveness of variations in the properties of our presentations by knowing precisely how our students interacted with those variations.

Accordingly, we have designed and constructed an aural learning laboratory[3] which is quite unique in the history of educational research, for it allows us to measure how students interact, during independent study, with details of our presentations for learning. That knowledge is "the other side of the coin", so to speak. We have always known what we say to students (at least in print), but we seldom have had the chance to measure how students react to particulars of our presentations, especially at the time they are first exposed to them. So SOS research should prove to be a useful approach for that reason alone.

A complete description of the technical aspects of our aural laboratory is beyond the scope of this paper and is being prepared as a separate article. We can, however, describe some general capabilities. The laboratory consists of two rooms -- an aural study room and a data recording and processing room. The aural study room has five student stations, each equipped with a play-back recorder (with variable speech compensator), a response recorder, a microphone, a head-set, and an intercom connection with the other lab room. That room contains equipment to record and process the study activity data coming from the aural study room. We have our own microprocessor, a multi-channel chart recorder and electronic counters to do the job.

The play-back decks in the aural study room have been modified to out-put electrical signals for all student operations performed during independent study. Those signals are fed into the microprocessor. Thus whenever any of five students working concurrently does the following things, they are recorded by the microprocessor: presses the play, stop, re-wind, or fast-forward buttons; moves the channel selector switch; changes tape speed (from a 20% decrement in normal play to a 50% increment); inserts or removes a cassette.

The recording of those study-activity events can provide a lot of information which is critical to our purposes. So they are of interest in and of themselves. Their usefulness is multiplied by the fact that they can all be related to the particular points in the tape where they occur. Since all our tapes are coded, whenever a student operates the play-back deck in any way, the microprocessor records the tape location at which that event took place. So, in effect, we can know not only that a student listens at different speeds, but what is heard at different speeds; not only that a student spent 28% of a study session in re-listening, but what was re-listened to and how often; and so on.

There is, of course, a great deal we will have to say about these data, their relations to data on evaluations of student comprehension, and, of special interest, their relations to independent presentation variables manipulated in experimental designs. Those reports will occur in other published articles to follow this one.

We have already identified relations among the study variables and are studying how well correlated they are with student comprehension scores from frequent and thorough evaluations, as well as student comments. Those relations are patterns of responding which may reflect differences in student comprehension at the time a student is studying a presentation. We are currently analyzing such patterns to see if we can reliably identify "comprehension patterns", "confusion patterns", "search and location patterns", and so on.

Our pilot experiments will investigate the functional dependence of study-activity patterns and comprehension scores on several independent variables. We are presently preparing tape-recorded materials in our adaptation structure where LS length is a variable. ——————→

Systematic replications of that experiment, with the subject matter recorded as a parameter, will follow. Data from those experiments showing relations among dependent variables will then be used to compare with data from the study of literal transcription tapes.

All this information should provide us will differential feedback on what is right and what is wrong with our preliminary adaptation structure. It should also lead us to some generalizations about the most effective ways a student can distribute his/her time during independent aural study.

Hopefully, we will soon have enough reason to consider all our tapes as drafts which can be improved upon. After re-writing and re-recording them, we plan to have the Lighthouse and other service agencies for the visually impaired field-test the new tapes, as well as our instructional procedures. While that is being done, we will continue the experimental analysis of our adaptation structure, for we are sure that the pilot research we have just mentioned represents a mere scratch on the surface of what there is to learn about with this new research tool.

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Footnotes

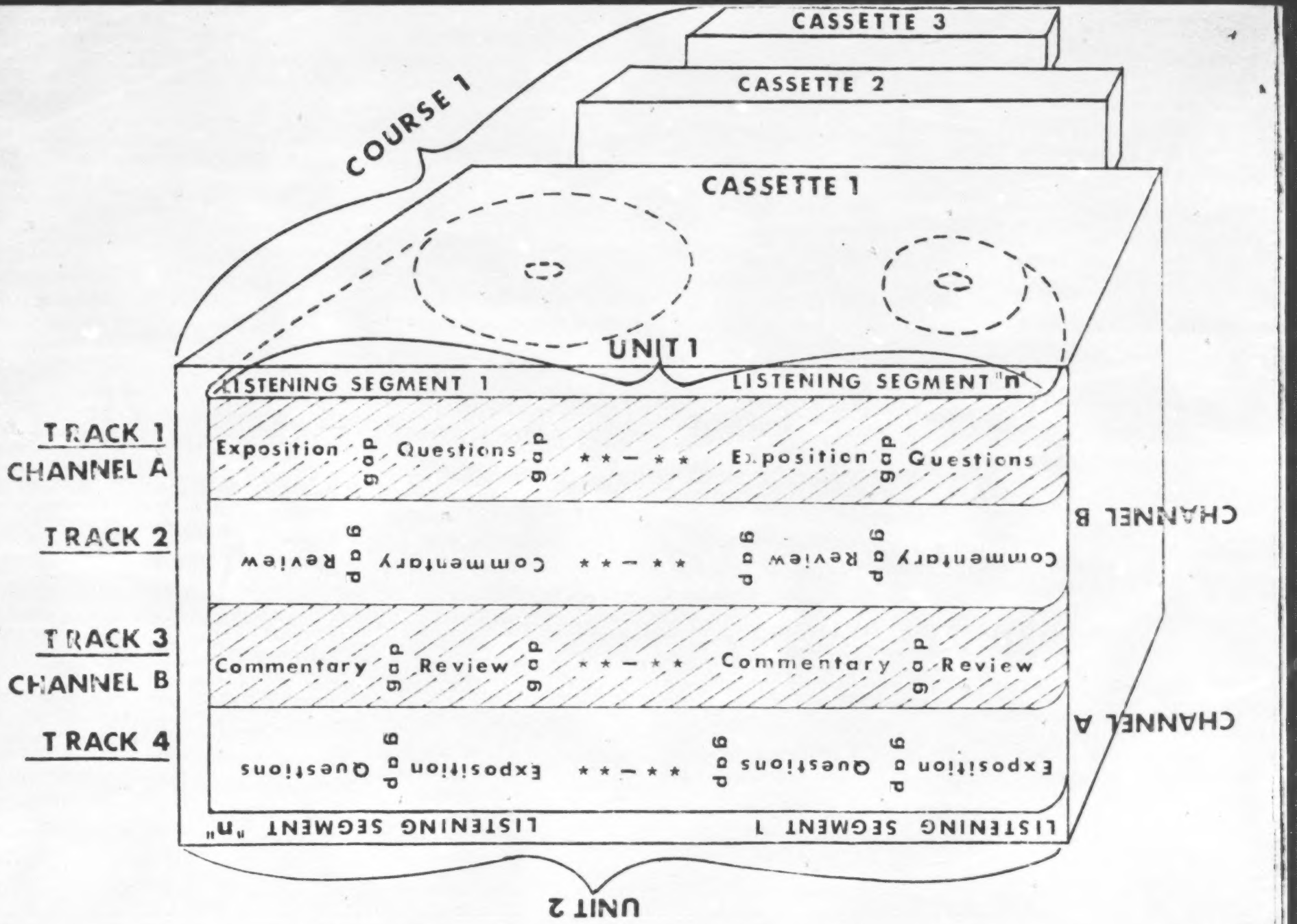
1. This project was supported by funds made available under the Adult Education Act as administered by the Bureau for Special Continuing Education of the New York State Education Department.

2. We have been the beneficiaries of advice from many people. We wish to acknowledge, in particular, the contribution of Dr. Emerson Foulke, the Director of the Perceptual Alternatives Laboratory, University of Louisville, Kentucky.

3. Dr. Thomas B. Perera, consultant to the LTL project, has mainly been responsible for this achievement. He designed the electrical circuits for our modified play-back decks, performed the modifications himself, and developed the data recording and processing system we are using.

Figure Legend

Figure 1. Parts of the preliminary adaptation structure for aural study are shown. Courses are tape-recorded on cassettes. Each side of a cassette is a unit (or tape). Material on each tape is divided into listening segments and each LS contains two channels, A and B. There are four main parts to each LS: exposition and questions (A), and commentary and review (B).



LEARNING THROUGH LISTENING FORMAT